

Mean Areas and Heliographic Latitudes of Sun-spots in the year 1902, deduced from Photographs taken at the Royal Observatory, Greenwich, at Dehra Dûn (India), and in Mauritius.

(Communicated by the Astronomer Royal.)

The results here given are in continuation of those printed in the *Monthly Notices*, vol. lxii. p. 378, and are deduced from the measurements of photographs taken at the Royal Observatory, Greenwich, at Dehra Dûn, India, and at the Royal Alfred Observatory, Mauritius.

Table I. gives the mean daily areas of umbræ, whole spots, and faculæ for each synodic rotation of the Sun in 1902; and Table II. gives the same particulars for the entire year 1902, and the thirteen preceding years for the sake of comparison. The areas are given in two forms: first, projected areas—that is to say, as seen and measured on the photographs, these being expressed as millionths of the Sun's apparent disc; and next areas as corrected for foreshortening, the areas in this case being expressed in millionths of the Sun's visible hemisphere.

Table III. exhibits for each rotation in 1902 the mean daily area of the whole spots, and the mean heliographic latitude of the spotted area, for spots north and for spots south of the equator; together with the mean heliographic latitude of the entire spotted area, and the mean distance from the equator of all spots; and Table IV. gives the same information for the year as a whole, similar results from 1889 to 1901 being added as in the case of Table II. Tables II. and IV. are thus in continuation of the similar tables for the years 1874 to 1888 on pp. 381 and 382 of vol. xlix. of the *Monthly Notices*.

The rotations in Table I. and Table III. are numbered in continuation of Carrington's series (*Observations of Solar Spots made at Redhill*, by R. C. Carrington, F.R.S.), No. 1 being the rotation commencing 1853 November 9.

The assumed prime meridian is that which passed through the ascending node at mean noon on 1854 January 1, and the assumed period of the Sun's sidereal rotation is 25.38 days. The dates of the commencement of the rotation are given in Greenwich civil time, reckoning from mean midnight.

No photographs have yet been received for four of the days included in the preparation of the following tables, but the director of the Mauritius Observatory has reported that photographs were taken there on those occasions, and that they have already been despatched to England. He further reported that the Sun was clear of spots upon three of the days. For the remaining day, values have been assumed for the areas and positions of the spots by taking the means of those obtained for the day preceding and for that following.

June 1903.

Latitudes of Sun-spots, 1902.

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TABLE I.

No. of Rotation.	Date of Commencement of each Rotation.	No. of Days on which Photographs were taken.	Mean of Daily Areas.					
			Projected.			Corrected for Foreshortening.		
			Umbrae.	Whole Spots.	Faculae.	Umbrae.	Whole Spots.	Faculae.
645	1901. d Dec. 14.20	28	20	122	20	11	67	26
646	1902. Jan. 10.53	26	9.2	67	73	6.1	45	92
647	Feb. 6.87	26	5.8	30	48	4.2	22	60
648	Mar. 6.21	27	37	224	195	2.9	179	210
649	Apr. 2.52	26	0.0	0.0	80	0.0	0.0	92
650	Apr. 29.77	25	2.9	21	103	3.0	21	122
651	May 27.00	27	11	44	184	6.7	28	244
652	June 23.20	27	0.1	1.0	62	0.1	0.9	62
653	July 20.40	22	0.0	0.5	23	0.0	0.3	25
654	Aug. 16.62	25	0.6	3.9	29	0.4	2.6	35
655	Sept. 12.87	27	35	198	230	16	146	279
656	Oct. 10.15	27	29	181	294	20	127	326
657	Nov. 6.45	27	35	222	320	24	166	346
658	Dec. 3.76	26	0.3	5.9	314	0.3	3.9	342

TABLE II.

Year.	No. of Days on which Photographs were taken.	Mean of Daily Areas.					
		Projected			Corrected for Foreshortening.		
		Umbrae.	Whole Spots.	Faculae.	Umbrae.	Whole Spots.	Faculae.
1889	360	17.9	103	107	13.1	78.0	131
1890	361	21.3	133	273	15.5	99.4	304
1891	363	120	745	1322	86.2	569	1412
1892	362	255	1596	3230	186	1214	3270
1893	362	327	1983	2287	234	1464	2404
1894	364	317	1728	1666	231	1282	1877
1895	364	237	1330	2059	169	974	2278
1896	364	127	745	1243	90	543	1410
1897	364	122	695	977	88	514	1149
1898	363	93	532	767	64	375	891
1899	364	27	159	297	18	111	337
1900	360	22	101	150	17	75	180
1901	359	14	41	23	8.6	29	29
1902	349	14	86	150	10	62	172

TABLE III.

No. of Rotation.	Date of Commencement of each Rotation.	No. of Days on which Photographs were taken.	Spots North of the Equator.		Spots South of the Equator.		Mean Heliographic Latitude of Entire Spotted Area.	Mean Distance from Equator of all Spots.
			Mean of Daily Areas.	Mean Heliographic Latitude.	Mean of Daily Areas.	Mean Heliographic Latitude.		
645	1901. d Dec. 14.20	28	0.3	26.70	67	7.95	- 7.82	8.02
646	1902. Jan. 10.53	26	0.0	...	45	7.41	- 7.41	7.41
647	Feb. 6.87	26	21	22.88	0.7	15.53	+ 21.58	22.63
648	Mar. 6.21	27	179	24.46	0.0	...	+ 24.46	24.46
649	Apr. 2.52	26	0.0	...	0.0
650	Apr. 29.77	25	21	25.95	0.0	...	+ 25.95	25.95
651	May 27.00	27	28	22.82	0.0	...	+ 22.82	22.82
652	June 23.20	27	0.9	26.08	0.0	...	+ 26.08	26.08
653	July 20.40	22	0.0	...	0.3	25.70	- 25.70	25.70
654	Aug. 16.62	25	2.6	27.50	0.0	...	+ 27.50	27.50
655	Sept. 12.87	27	78	13.06	68	20.95	- 2.80	16.74
656	Oct. 10.15	27	40	9.88	87	20.72	- 10.99	17.27
657	Nov. 6.45	27	165	14.81	1.2	20.59	+ 14.55	14.85
658	Dec. 3.76	26	3.4	21.23	0.5	18.95	+ 16.46	20.96

TABLE IV.

Year.	No. of Days on which Photographs were taken.	Spots North of the Equator.		Spots South of the Equator.		Mean Heliographic Latitude of Entire Spotted Area.	Mean Distance from Equator of all Spots.
		Mean of Daily Areas.	Mean Heliographic Latitude.	Mean of Daily Areas.	Mean Heliographic Latitude.		
1889	360	5.0	7.26	73.0	11.90	- 10.68	11.61
1890	361	53.1	22.20	46.3	21.75	+ 1.73	21.99
1891	363	401	20.49	169	19.91	+ 8.52	20.31
1892	362	607	15.09	607	21.69	- 3.29	18.39
1893	360	517	14.91	941	14.26	- 3.93	14.49
1894	364	543	12.31	739	15.56	- 3.75	14.18
1895	364	565	14.26	409	12.54	+ 3.01	13.54
1896	364	203	13.60	340	14.77	- 4.15	14.33
1897	364	196	8.32	318	7.73	- 1.62	7.96
1898	363	110	9.82	266	10.77	- 4.75	10.49
1899	364	23	6.18	88	10.43	- 6.95	9.54
1900	360	26	6.61	49	8.34	- 3.12	7.74
1901	359	22	8.59	6.6	16.27	+ 2.82	10.37
1902	349	42	18.81	21	15.35	+ 7.38	17.65

The principal features of the record for 1902 are :—

1. The increase in area, which has been shown alike by umbræ, whole spots and faculæ, indicates that the minimum is definitely over and that the period of revival has begun.

2. For the whole spots the mean daily area has been more than double what it was in 1901, but has not been quite equal to that for 1900.

3. There has been an increase in the area of the umbræ, but this has been only slight.

4. The increase in the area of the faculæ has been very striking, especially during the last four rotations of the year.

5. Comparing the whole spots of the two hemispheres, the area for the northern has been just double that for the southern, but the rate of increase has been slightly the larger for the southern hemisphere.

6. The southern hemisphere was in a condition of practically undisturbed quiescence for eight rotations in succession.

7. The distribution of spots in latitude has been very characteristic of the beginning of a new cycle. The majority of the spots in both hemispheres were in high latitudes, extending from 17° to 28° , and there was one instance in each hemisphere of a group in a latitude considerably higher still. The equatorial region was entirely deserted, no group having a latitude of under 7° ; but there was a distinct belt of activity just beyond that limit, whilst there were none in the zone extending from 10° to 14° . Regarding the spots in each hemisphere as divided into two distinct regions by this barren zone, their areas and mean latitudes were :

	Spots North of the Equator.		Spots South of the Equator.	
	Mean of Daily Areas.	Mean Heliographic Latitude.	Mean of Daily Areas.	Mean Heliographic Latitude.
Low latitude spots ...	7.4	$9^{\circ}85$	8.7	$7^{\circ}74$
High „ „ ...	34.1	$20^{\circ}74$	12.2	$20^{\circ}81$

The highest latitude recorded was 39° .

8. The days without spots were 248 in number, as compared with 289 in 1901; indicating an increase of activity indeed, but much less decidedly than the comparison of areas does. The earlier rotations of the year furnished much the largest portion of these spotless days, whilst rotations 655 to 659 were the only rotations of the year in which the number of days without spots did not greatly exceed one half of the total number of days of observation.

9. The number of separate groups of spots was considerably greater than in 1901, the numbers being 14 for 1901 and 35 for 1902. Of these 35, 24 groups were in the northern hemisphere and 11 in the southern.

Royal Observatory, Greenwich :
1903 June 11.

The Spectra of Sun-spots in the Region B-D.

By the Rev. A. L. Cortie, S.J.

The present paper is in continuation of that published in the *Memoirs* (vol. 1. p. 30-56), which discussed the observations made of the spectra of ninety Sun-spots in the years 1882-89 at the Stonyhurst College Observatory. Since that period only occasional observations of the spectra of Sun-spots have been secured—some twenty-four in all—covering the period 1890-1901. The dates of the several observations were :—1890 September 16, 1891 August 18, 30, September 3, 4, 7, 23, 28 ; 1894 November 30, December 3 ; 1896 June 15, November 5, 6, 8 ; 1898 March 11, October 8, 10 ; 1899 March 22, 24 ; 1900 March 11, October 22 ; and 1901 May 22, 23, 24. The instrument employed was the Browning automatic prism spectroscope, a dispersion of twelve prisms of 60° being in most cases used. The spectroscope was attached to the 15-inch Perry memorial refractor. The method of observation was first to pass the region B-D in review, so as to pick out the lines most affected, and then to study some particular portion of the spectrum. This latter operation is exceedingly tedious and laborious, so that a detailed study of the whole of the region B-D has only been possible on one or two occasions. In the above list of dates the most complete observations were obtained on 1891 September 3, 4, 7. For the identification of the lines the beautiful photographic maps of Mr. Higgs were used. The results of the observations are collected in the following table, which gives a list of 300 lines affected in Sun-spots in this region of the spectrum. The first column gives the wave-lengths of the lines according to Rowland's values in his "Preliminary Table of Solar Spectrum Wave-lengths." Lines observed in the spectrum of the chromosphere by Professor Young are marked with an asterisk. They are taken from his revised list (Scheiner's *Astronomical Spectroscopy*, Frost's edition, p. 423). The origins of the lines are also taken from Rowland's table, as also their intensities. Intensity 1 corresponds to a line just visible on Rowland's map, the intensity of H and K on this scale being 1,000. Below 1 the successive orders of faintness are indicated by successive zeros. The third column gives the number of times each line of the list has been observed, and the fourth its mean widening, estimated as far as possible in tenths of the normal width of the line. Lines of which the widening is 1.0 and over would correspond to the most widened lines of other observers. A column is reserved for remarks on the several lines. In former papers on this subject, and especially in the *Memoir* (*loc. cit.*), the wave-lengths of the lines were taken from the reports of the British Association. These differ by about one unit from Rowland's values now adopted.